

California Environmental Protection Agency

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## **Pleasure Craft Evaporative Emissions Test Procedure**

**TP-1503**

**Test Procedure for Determining Carbon Canister Performance:  
Durability Demonstration and Working Capacity**

**Draft Proposed: February 25, 2009**

**TP-1503**  
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**California Environmental Protection Agency  
Air Resources Board  
Pleasure Craft Evaporative Emissions Test Procedure**

**TP-1503**

**Test Procedure for Determining Carbon Canister Performance: Durability  
Demonstration and Working Capacity**

A set of definitions common to all Certification and Test Procedures are in Title 13, California Code of Regulations (CCR), section 2752 et seq. For the purpose of this procedure, the term "CARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the CARB Executive Officer, or his or her authorized representative or designate.

**1 APPLICABILITY**

This Test Procedure is used by the Air Resources Board to determine the performance of carbon canisters used to control evaporative emission from pleasure craft. Pleasure craft are defined in Title 13, California Code of Regulations (CCR), section 2790 et seq. This Test Procedure is proposed pursuant to section 43824 of the California Health and Safety Code (CH&SC) and applies to engine or equipment manufacturers seeking an Executive Order for an evaporative control system utilizing a carbon canister.

**1.1 Requirement to Comply with All Other Applicable Codes and Regulations**

Approval of an evaporative emission control component, technology, or system by the Executive Officer does not exempt the same from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

**1.2 Safety**

This test procedure involves the use of flammable liquids and operations and should only be used by or under the supervision of those familiar and experienced in the use of such materials and operations. Appropriate safety precautions should be observed at all times while performing this test procedure.

**2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE**

These test procedures are designed to provide consistent methods to evaluate the durability and working capacity of carbon canisters utilized in pleasure craft.

Working capacity is a defining parameter expressing the mass of hydrocarbons that can be stored in the canister under controlled conditions. The canister's working capacity is established by repeated canister loading and purging. This procedure involves a cycle that includes a 400 bed volume purge, a 5 minute pause, and then loading the canister with butane mixed 50/50 by volume with air or nitrogen to a measured breakthrough.

### 3 BIASES AND INTERFERENCES

To accurately quantify the working capacity, the complete test system must be leak tight. Loose fittings and connectors may result in leaks that can significantly affect working capacity determinations.

Care should be taken to minimize or limit the humidity of the air or nitrogen used to purge the canister. Humid purge air can bias canister desorption weight measurements. Dryerite ( $\text{CaCl}_2$ ), or other suitable dehumidification methods, must be used to control the humidity of the purge air.

### 4 SENSITIVITY AND RANGE

The minimum sensitivity of the balance must be selected using good engineering judgment.

### 5 EQUIPMENT CALIBRATIONS

Mass flow meters must undergo an annual multiple point calibration with a primary standard and have a  $R^2$  coefficient of 0.99 or greater.

The top loading balance must be calibrated with ASTM Class I weights prior to use per the manufacturer specifications. Prior to use the balance must be challenged with weights above and below the range of mass measurements.

### 6 CARBON CANISTER WORKING CAPACITY DETERMINATION

#### 6.1 Number of Test Cycles

Working capacity is determined through cyclic loading and purging of a carbon canister. Ten or more cycles may be required to stabilize new carbon. A minimum of three cycles is adequate if the carbon has a previous history of stabilization with butane or gasoline vapors. The “working capacity” value is the average of the butane mass supplied to the canister for the last two repeatable cycles.

#### 6.2 Canister Purge

The sequence starts by first purging the canister with 400 bed volumes of dry air or nitrogen in 30 minutes at laboratory conditions. Bed volume is the design volume of the carbon contained in the canister. Purge for all the canister models is defined as a 400 bed volume purge in approximately 30 minutes. The purge rate will therefore vary with canister size. Purge may be accomplished by drawing a vacuum at the tank or purge port, or by pushing air or  $\text{N}_2$  into the atmospheric vent.

### 6.3 Pause

Pause testing for approximately 5 minutes between purge and load sequence and also between load and purge sequence.

### 6.4 Measurement

Weigh the test canister before and after each canister load sequence.

### 6.5 Canister Load

Load the test canister with butane mixed 50/50 by volume with air or nitrogen until the specified breakthrough criteria has been met. The canister load is accomplished by flowing the butane mixture into the canister via the tank fitting. The butane load rates and breakthrough criteria are determined by canister's bed volume. In order to accommodate the expected wide range of canister bed volumes expected in pleasure craft, four ranges of canister loading and breakthrough criteria are defined: small (< 99cc), medium (100 to 249cc) large (249 to 550cc) and extra large (> 550cc). The load and breakthrough criteria are defined as follows:

Carbon Canister Bed Volume	Small < 99cc	Medium 100cc to 249cc	Large 249cc to 550 cc	Extra Large >550 cc
Butane Load Rate [grams $C_4H_{10}$ / hour]	5.0	10.0	15.0	15.0
Break-through limit [grams](*)	2.0	2.0	2.0	2.0

(\*). If the canister shows weight loss prior to the 2.0 grams breakthrough then an alternate lower breakthrough limit can be used.

## 7 CALCULATING RESULTS

The working capacity is the average test canister weight gain in grams determined from the last two load cycles. The resultant working capacity is expressed in grams of  $C_4H_{10}$

## 8 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

This section is reserved for future specification.

## 9 RECORDING DATA

Record data on a form similar to the one shown in Figure 1 (see page 4).

## 10 FIGURES

Figure 1. Canister Data Sheet

Figure 1  
Canister Data Sheet

Canister Manufacturer:

Canister I.D:

Tested By:

Canister Volume [cc]:

Canister Purge Data

Time Start/End	Duration [seconds]	Flow Rate Q [LPM]	Initial Weight W <sub>i</sub> [grams]	Final Weight W <sub>f</sub> [grams]	Weight Loss W <sub>l</sub> [grams]

Canister Load Data

Time Start/End	Duration [seconds]	Butane Rate Q <sub>b</sub> [g/hr]	Initial Weight W <sub>i</sub> [grams]	Final Weight W <sub>f</sub> [grams]	Break- Through W <sub>b</sub> [grams]	Weight Gain W <sub>g</sub> [grams]
Working Capacity [grams C <sub>4</sub> H <sub>10</sub> ]						